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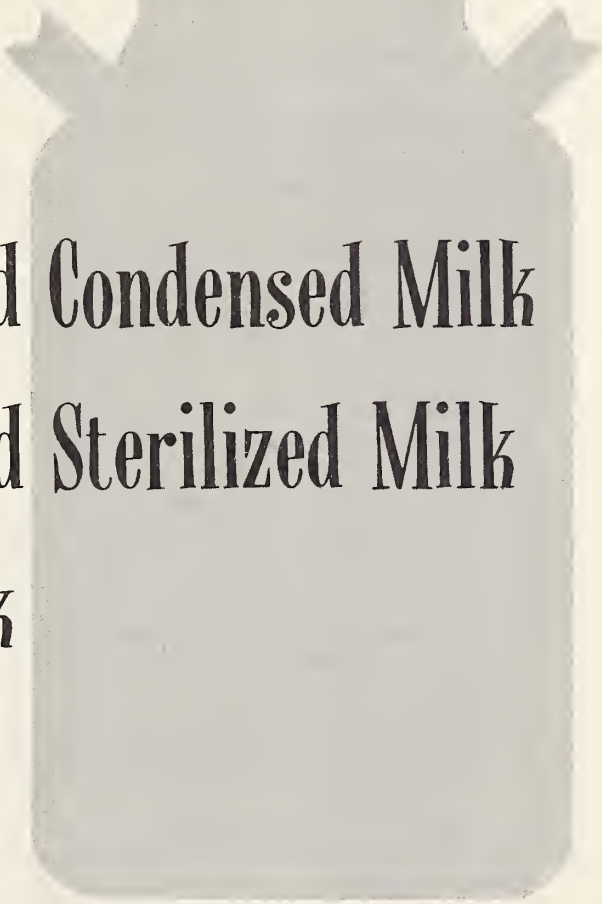

Recombined Condensed Milk
Recombined Sterilized Milk
Toned Milk

Useful Products for Milk Deficit Areas

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This publication supplements these two reports of the Foreign Agricultural Service:

Foreign Agriculture Report No. 84, Recombined Milk (1955), which gives technical information on the establishment of plants for the production of recombined fluid milk from the recombining ingredients low heat, spray process, nonfat dry milk, and anhydrous milk fat.

FAS-M-21, How To Use Recombined Milk Ingredients in Manufacturing Dairy Products (1957), which further expands on the story of how recombining can be used to create a supply of not only fluid milk but also manufactured dairy products in countries and areas of the world where the milk supply is inadequate to meet consumer demand.

RECOMBINED CONDENSED MILK
RECOMBINED STERILIZED MILK
TONED MILK

Useful Products for Milk Deficit Areas

By L. H. Burgwald and D. R. Strobel[1]

Canned unsweetened condensed milk and sweetened condensed milk are the major sources of dairy products for many peoples of the world, especially those in underdeveloped countries where milk supplies are relatively small. The production of the canned milks in the countries themselves from nonfat dry milk and anhydrous milk fat could further increase the use of these dairy products. Also, it could contribute to the overall economy of the countries, in that the production would utilize local labor and facilities.

In many hot countries where both milk and refrigeration are scarce, sterilized recombined fluid milk could also play an important part in broadening the use of dairy products and in raising nutrition levels. Unlike unsweetened and sweetened condensed milk, which have part of the water removed in the processing, sterilized milk is recombined fluid milk which has been subjected to high temperatures to preserve it so that it can be stored without refrigeration.

Another use for nonfat dry milk in milk-short areas is in toned milk. In many underdeveloped countries the chief source of milk supply is the buffalo rather than the milk cow. Buffalo milk will average as high as 7-percent milk fat. In some of these countries, reconstituted nonfat dry milk is being added to this high-fat milk to produce "toned" milk of a lower fat content. The use of nonfat dry milk in this manner "stretches" the local milk supply with a resulting product that is still highly nutritious.

Condensed Milk

Unsweetened condensed milk.--Recombined unsweetened condensed milk can be made from anhydrous milk fat, nonfat dry milk, and water without using a vacuum pan.

To produce 100 pounds (45.45 kg.) of recombined unsweetened condensed milk with a composition of 7.9-percent fat and 25.9-percent total solids, thoroughly mix 18.0 pounds (8.18 kg.) of nonfat with the 74.1 pounds (33.68 kg.) of water, add 7.9 pounds (3.59 kg.) of fat, and heat the mixture to 150°F. (65.5°C); then homogenize the product at 2,000 to 2,500 pounds' pressure per square inch, and cool to 40°F. (4.4°C).

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Fill the cans. If batch sterilizers are used, the cans can be 6 ounce, 14 ounce, 14 1/2 ounce, or a gallon. If a continuous sterilizer is used, only a standard 14 1/2 ounce and a baby-size 6 ounce can can be used. Batch sterilizers are adaptable to any size plant, but the continuous sterilizer is best adapted to large plants with an output of 500 cases or more per day.

Batch sterilizers must operate at a temperature of 240°F. to 245°F. (115.6°C. - 118.3°C.) for not less than 15 minutes. The time required to raise the temperature from room temperature to 240°F. (115.6°C.) should be not less than 15 minutes nor more than 20 minutes.

The batch sterilizer makes use of a revolving crate, or cage, to keep the cans turning over until the desired temperature is reached. A quantity of water is used in the sterilizer to shorten the time needed to reach the desired temperature and to give a more uniform heating of the milk. During the holding time, the reel is stopped.

Immediately after the holding period, the steam is turned off, exhaust and drains are opened, and, with the reel running, cold water is turned into the sterilizer until the temperature of the milk reaches 70° to 80°F. (21.1 - 26.7°C). This should not take more than 15 minutes.

Continuous sterilizers consist of three units--the preheater, the sterilizer, and the cooler.

As the cans enter the preheater, the temperature is raised gradually to 208° to 210°F. (97.8 - 98.9°C). On leaving the preheater the cans pass through a leaky-can detector into the sterilizer. Owing to heat expansion, bulged cans are good, unbulged are leakers.

The usual time in the sterilizer is 15 to 17 minutes at a temperature of 238 to 245°F. (114.5° - 118.3°C). For a sterilizing temperature of 238°F. (114.5°C.) the holding time is 17 minutes. The "standard process" is 242°F. (116.7°C.) for 15 minutes.

The sterilizer unit is equipped with a variable-speed transmission and quick-change temperature control so devised that time and temperature of the process can be quickly changed at will.

From the sterilizer the cans go into the cooling unit, which operates with 10 pounds' air pressure. This prevents strain on the cans from internal pressure until the cans have been sufficiently cooled to eliminate the internal pressure and are released into the atmosphere.

Sweetened condensed milk.--Recombined sweetened condensed milk can be made from anhydrous milk fat, nonfat dry milk, water, and sugar without a vacuum pan.

To make 100 pounds (45.45 kg.) of recombined sweetened condensed milk with a composition of 9.0-percent fat, 21.0-percent milk solids not fat, and 43.0-percent sugar, use the following quantities: 9.0 pounds (4.1 kg.) of anhydrous milk fat, 21.0 pounds (9.55 kg.) of low-heat, nonfat dry milk,

43.0 pounds (19.55 kg.) of sugar, and 27.0 pounds (12.27 kg.) of water.

To prepare the 100 pounds of product, thoroughly mix 10.0 pounds (4.55 kg.) of the nonfat dry milk with 27.0 pounds (12.27 kg.) of water, add 9.0 pounds (4.1 kg.) of anhydrous milk fat, heat to 160°F. (71.1°C.), and homogenize at 2,000 to 2,500 pounds' pressure per square inch. Then heat the mixture to 180°F. (82.2°C).

Mix the remaining 11.0 pounds (5.0 kg.) of nonfat dry milk with 43.0 pounds (19.55 kg.) of sugar, and add slowly to the portion of the mixture already prepared. Stir constantly and vigorously, and maintain the heat at 180°F. (82.2°C.). Cool the recombined milk quickly to 86°F. (30°C.), add 2.0 ounce (57.0 gms.) of finely powdered lactose[2] or 1.5 to 2.0 pounds (0.68 - 0.90 kg.) of a previous batch of sweetened condensed milk. Hold the product at 86°F. (30°C.) for 1 hour with vigorous agitation; then cool rapidly to 65°F. (18.3°C.) with constant agitation prior to canning. The milk may be placed in sterile tin cans or sterile glass bottles.

Sterilized Milk

The preparation of recombined fluid milk is described in Foreign Agriculture Report No. 84, Recombined Milk. To prepare a "sterilized" fluid recombined milk, the recombined milk is heated to 160°F. (71.1°C.), homogenized at 2,000 to 2,500 pounds' pressure per square inch and the bottles (6 oz., 8 oz., or 16 oz.) are filled with the hot milk (sufficient airspace must be left in the bottle to allow for expansion during sterilization). The glass bottles used should have tight sealing metal caps with nonabsorbent liners.

The filled bottles are then placed in wire cases and stacked in a steam chest or other proper sterilizing equipment. The milk is sterilized at 220°F. (104.5°C.), (7.5 pounds' steam pressure) for 40 minutes or at a temperature and time determined experimentally to be adequate for complete sterilization for the quality of the milk being processed.

At the end of the sterilization period the steam is shut off and the pressure is permitted to drop slowly. The bottles, after being removed from the sterilizer, are air cooled.

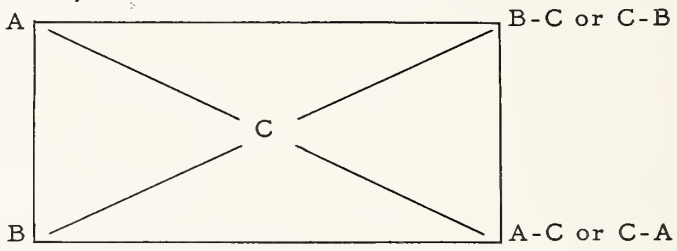
If metal cans are used in place of glass bottles, the same procedure is used as for sterilizing unsweetened condensed milk.

Toned Milk

Toned milk is a high-fat milk to which reconstituted nonfat dry milk or skim milk has been added to decrease the fat

[2] If powdered lactose is added for seeding, it should first be mixed thoroughly (until smooth) with several pounds of the sweetened condensed milk before adding to the total batch being prepared.

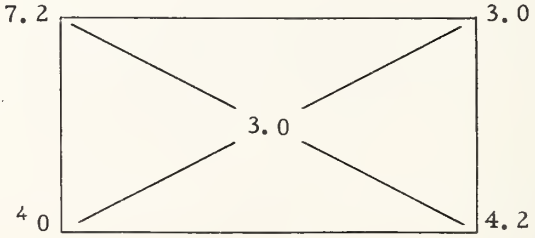
content of the original milk. The lowering of the fat content produces a larger volume of milk. In the process of toning, it is necessary to determine the fat percentage of the milk to be toned and also to determine the quantity of reconstituted nonfat dry milk or skim milk to be added to lower the fat content of the original milk to the desired level. The simplest method developed for this determination is known as the parallelogram, or "Pearson square"[3] method. The method may be illustrated as follows:



A = the percent of fat in the milk to be toned.
B = the percent of fat in the reconstituted nonfat dry milk or skim milk to be mixed with A to reduce the fat content of A.
C = the percent of fat desired in the toned milk.

By subtracting diagonally, the proportionate amounts of A and B required to be mixed to obtain a mixture containing the desired percent of fat indicated by C are secured. In other words, A-C or C-A (depending on which is the larger) will give the number of kilograms or pounds of B to be taken for the mixture. In a like manner C-B or B-C will show the number of kilogram or pounds of A to be taken for the mixture.

The following will further illustrate the procedure. For example, how many kilograms of reconstituted nonfat dry milk or skim milk will be required to standardize or tone 750 kilograms (1,650 lbs.) of milk testing 7.2-percent milk fat so that the resulting mixture will contain 3.0 percent milk fat?



[3] This method of standardizing or toning milk is named for Professor Pearson, who devised it at Cornell University many years ago.

[4] If the skim milk contains some milk fat, the percentage of fat would be entered here.

The diagram shows that 3 kilograms (6.6 lbs.) of the 7.2-percent milk and 4.2 kilograms (9.24 lbs.) of reconstituted nonfat dry milk or skim milk will be required to make 7.2 kilograms (15.84 lbs.) of a 3-percent standardized or toned milk. When nonfat dry milk is used, it is reconstituted on the basis of 4.1 kilograms (9 lbs.) of nonfat dry milk to 41.3 kilograms (91 lbs.) of water.

The amount of skim milk or reconstituted nonfat dry milk necessary to add to the total quantity of 750 kilograms (16.50 lbs.) of 7.2-percent milk is determined as follows:

$3 : 4.2 = 750 : X$ [5/]

$3X = 3,150$

$X = 1,050$ kilograms (2,310 lbs.) of reconstituted nonfat dry milk or skim milk required.

To make the 1,050 kilograms (2,310 lbs.) of skim milk containing 9-percent solid-not-fat from nonfat dry milk requires, $1,050 \times 0.09 = 94.5$ kilograms (207.9 lbs.) of nonfat and 955.5 kilograms (2,102.1 lbs.) of water.

The 1,050 kilograms (2,310 lbs.) of reconstituted nonfat dry milk or skim milk added to the 750 kilogram (1,650 lbs.) of the original milk testing 7.2-percent milk fat will result in 1,800 kilograms (3,960 lbs.) of a toned milk testing the desired 3-percent milk fat.

To prove the calculation, the following is done: The original 750 kilograms (1,650 lbs.) of 7.2-percent fat milk contains 54 kilograms (118 lbs.) of milk fat ($750 \times 0.072 = 54$). The original 750 kilograms (1,650 lbs.) added to the 1,050 kilograms (2,310 lbs.) of the reconstituted nonfat dry milk or skim milk produces a total of 1,800 kilograms (3,960 lbs.) of the toned milk calculated to contain 3-percent milk fat. $1,800 \times 0.03$ (3 percent) = 54 kilograms of milk fat. Thus, the total amount of finished product is shown to contain the original amount of milk fat contained in the original quantity of 7.2-percent fat milk. Therefore, the calculation is accurate.

[5/] X represents the amount of reconstituted nonfat dry milk or skim milk required to mix with the 750 kilograms (1,650 lbs.) of 7.2-percent fat milk.

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